LA-UR-22-20586

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Title:	Automated Growth of Photocathodes
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Intended for:	DisrupTECH Lightning Talk
Issued:	2022-01-24

Los Alamos
NATIONAL LABORATORY

Application

Richard P. Feynman Center for Innovation

Automated Growth of Photocathodes

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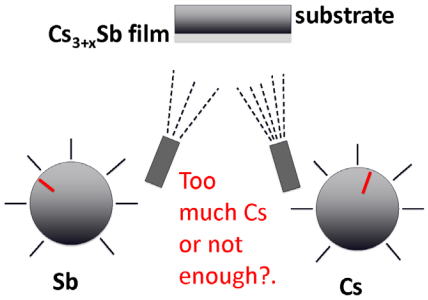


PROBLEM

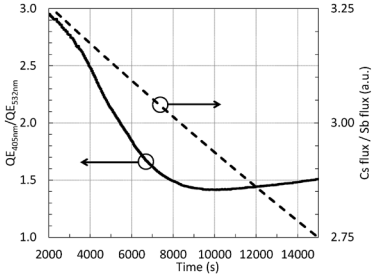
Photocathode (alkali antimonides & tellurides) thin film growth state of the art remains largely an art of "cooking" instead of a controlled technological process.

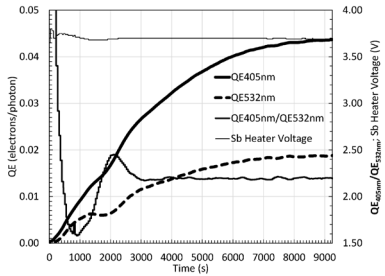
APPLICATION

Alkali antimonide photocathode thin films are sensitive to visible light and are commonly used in:

1. Sources of electrons for charged particle accelerators and related facilities such as free electron lasers (FELs).
2. High sensitivity photometry devices such as phototubes, photomultipler tubes (PMTs), etc.

Photocathode films used in accelerators have limited lifetime so they need to be periodically replaced (grown on demand).





SOLUTION

Our technology is a method of growing thin films by molecular beam deposition, that applies specifically to photoemissive films. We discovered that some of the photoemissive properties of Cs_3Sb (easily measurable) strongly depend on the film's stoichiometry (very difficult to measure, especially in real time). Such correlation allows to implement a feedback loop that adjusts the ratio of Cs and Sb fluxes in real time and thus maintains the same stoichiometric composition of the film during the whole growth cycle that may last for hours/days. Proposed scheme constitutes true, robust and versatile process control for the growth of alkali antimonide thin films.

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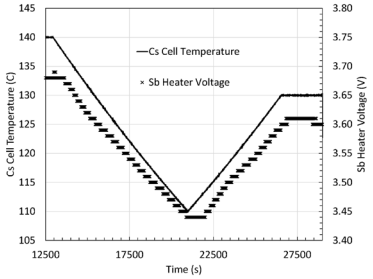
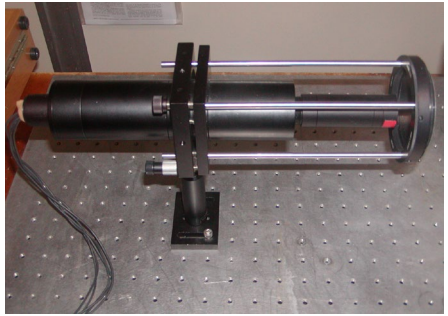
BENEFITS

It is the only automated growth solution for alkali antimonides, offering unprecedented (a) reproducibility, (b) real-time quality/stoichiometery control, (c) choice of growth rate including variable, and (d) ultra-low substrate temperature growth. It is a tool to define growth recipes that are not to be followed blindly, but with a focus on the final product instead.

COMPETITIVE ADVANTAGE

No other existing solution offers true feedback loop-based growth process control. Largely, every single photocathode thin film sample grown today in any lab or facility is unique. All recipes are proprietary and cannot be easily transferred to another system. Proposed solution can change the definition of a recipe, making them transferrable (if desired) to another facility and unambiguous.





TECHNOLOGY STATUS AND NEXT STEP

Technology was developed as part of LDRD ECR project and its further maturation goes beyond LDRD mandate. Future development would be best done within the scope of a bi- or tri-lateral technology transfer/maturation project that includes LANL (inventor, originator), private company (manufacturer), and a large scale facility such as SLAC (consumer).

TECHNOLOGY READINESS LEVEL AND IP

TRL 4: Automated growth of Cs_3Sb was successfully demonstrated in LANL's ACERT lab. Although the basic principle is fairly simple (feedback loop to stabilize a relevant parameter), multiple proprietary technical solutions that enable the technology might be patentable.